

# COLUMBIA COUNTY STORMWATER AND EROSION CONTROL ORDINANCE NOVEMBER 21, 2001

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**COLUMBIA COUNTY**  
**STORMWATER AND EROSION CONTROL ORDINANCE**  
NOVEMBER 21, 2001

**I. INTRODUCTION**

**A. Purpose**

1. The purpose of this ordinance is to:
2. Prevent water quality degradation of the county's water resources;
3. Prevent damage to property from increased runoff rates and volumes;
4. Protect the quality of waters for drinking water supply, contact recreation, fisheries, irrigation, and other beneficial uses;
5. Establish sound developmental policies which protect and preserve the county's water and land resources;
6. Protect county roads and rights-of-way from damage due to inadequately controlled runoff and erosion;
7. Protect the health, safety, and welfare of the inhabitants of the county;
8. Maintain existing instream flows; and
9. Preserve and enhance the aesthetic quality of the county's water resources.

**B. Applicability**

1. Provisions of this ordinance apply to:
  - a. Building permits for residential, commercial, industrial and accessory uses that involve disturbing more than 2000 square feet of land or activities disturbing more than 1000 square feet of land on sites with known and apparent erosion problems;
  - b. Grading permits that involve disturbing more than 2000 square feet of land or activities disturbing more than 1000 square feet of land on sites with known and apparent erosion problems;
  - c. Applications for partitions and subdivisions;
  - d. Drainage modifications involving the construction of storm pipes, culverts, channels, embankments, or other flow-altering structures in any stream, stormwater facility, or wetland; and
  - e. Construction of new public roads.
2. The following activities are specifically excluded from the provisions of this ordinance:
  - a. Farm Use activities as defined by ORS 215.203 and the construction of farm agricultural buildings exempt from permitting requirements of the Oregon Structural Specialty Code as provided by ORS 415.315;
  - b. Activities regulated under the Oregon Forest Practices Act;
  - c. Surface mining;
  - d. Landscaping and gardening activities that involve moving less than 50 cubic yards of soil and thus not requiring a grading permit;
  - e. Maintenance activities on roads and stormwater facilities;
  - f. Drainage modifications performed by Water Improvement, Irrigation, Drainage, and Water Control Districts and companies;
  - g. Emergency fire fighting activities;
  - h. Activities not meeting the applicability criteria of this ordinance as defined in subsection 1 above.
3. The provisions of this ordinance provide clarification for related provisions in the following sections:
  - a. Subdivision Ordinance, Article 9, Sec. 912(A)-Drainageways
  - b. Zoning Ordinance, Section 1550 – Site Design Review
  - c. UBC, Chapter 33 and CABO, Chapter 38
  - d. Road Standards, Section 6

### C. Definitions

For the purposes of this ordinance, the following definitions shall apply:

1. “*Alternative treatment methods*” means the use of certain manufactured products to treat stormwater runoff. Alternative treatment methods include *Stormfilters*™ manufactured by Stormwater Management, Inc. of Portland, Oregon and products providing an equivalent level of pollutant removal from runoff.
2. “*Best management practice*” or “*BMP*” means those physical, structural and managerial practices, and prohibitions of practices, that, when used singly or in combination, control and treat stormwater runoff and prevent or reduce erosion.
3. “*Board*” means the Board of County Commissioners of Columbia County.
4. “*Design storm*” means the rainfall from a storm of 24-hour duration. Specifically, a 100-year, 24-hour storm means the total rainfall in a 24-hour period that has a 1% probability of occurring in any given year. The design storms for Columbia County are provided in Appendix E.
5. “*Drainage modification*” means construction of storm pipes, culverts, channels, embankments, or other flow-altering structures in any stream, stormwater facility, or wetland.
6. “*Engineer*” means a Registered Professional Engineer, licensed in the State of Oregon, who is experienced and knowledgeable in the practice of civil engineering related to stormwater runoff and erosion control.
7. “*Erosion Control Manual*” or “*ECM*” means Section 3 of the Erosion Prevention and Sediment Control Plans Technical Guidance Handbook developed by the City of Portland Bureau of Environmental Services and the Unified Sewerage Agency of Washington County, dated February 1994.
8. “*Impervious surface*” means a hard surface area that either prevents or retards the entry of water into the soil. Examples include, but are not limited to, structures, walkways, patios, driveways, carports, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, haul roads and soil surface areas compacted by construction operations, and oiled or macadam surfaces.
9. “*Known and Apparent Erosion Problems*” means any documented erosion problems on file or know to exist. Documents may consist of records, maps, publications, newspaper articles, photographs, or other documents from DOGAMI, ODOT, County Road Department, County Enforcement, Soil and Water Conservation District, Natural Resource Conservation Service, or other agencies.
10. “*Land-disturbing activity*” means any activity that results in a change in the existing soil cover (both vegetative and nonvegetative) or existing soil topography. Land-disturbing activities include, but are not limited to, demolition, construction, clearing, paving, grading, filling and excavating.
11. “*New public road*” means creation of a new road or the addition of 4 feet or more to an existing road where the road is owned and maintained by a public agency and is used by motorized vehicles.
12. “*Peak discharge*” or “*Peak flow*” means the maximum stormwater runoff rate in cubic feet per second determined for the design storm.
13. “*Percent Slope*” means rise over run with the run standardized at 100 feet. For example, if over a run of 100 feet, the rise is 2 feet, then the percent slope is 2 feet/100 feet or 0.02 or 2% slope.
14. “*Pre-development*” means the historical land use on a site as demonstrated by evidence acceptable to the county. Acceptable evidence includes, but is not limited to, aerial photos from the Soil Survey of Columbia County, Oregon published by the United States Dept. of Agriculture.
15. “*Soil hazard areas*” means those areas where the possibility of landslides or other unique soil conditions makes infiltration of stormwater runoff inadvisable.
16. “*Stormwater facility*” means the natural or constructed components of a stormwater drainage system, designed and constructed to perform a particular function, or multiple functions. Stormwater facilities include, but are not limited to, pipes, swales, ditches, open channels, culverts, storage basins, infiltration devices, catch basins, manholes, dry wells, oil/water separators, and sediment basins.
17. “*Tidal waterbodies*” means large waterbodies that respond to the tides where control of runoff through detention has no measurable impact on the receiving waterbody. Waterbodies in this category include the Columbia River, Multnomah Channel, and Scappoose Bay only.

18. “*Water quality storm*” means the rainfall from a six-month, 24-hour storm. This rainfall equals approximately 64% of rainfall from the 2-year, 24-hour storm or 0.83 inches.
19. “*Water resources*” means streams, wetlands, lakes, ponds, and ditches that provide beneficial uses including, but not limited to: fisheries, contact recreation, stormwater conveyance, irrigation, and drinking water.

**D. Enforcement**

1. The Columbia County Land Development Services Director is authorized to enforce the provisions of this ordinance applicable to land use and building permits; as specified in the subdivision ordinance, zoning ordinance, and building code; utilizing the remedies and procedures of the Columbia County Enforcement Ordinance.
2. The Columbia County Public Works Director is authorized to enforce the provisions of this ordinance applicable to the county Road Standards.

## **II. GENERAL REQUIREMENTS**

The following requirements apply to all activities regulated under this ordinance:

### **A. Additional erosion control measures**

Where the measures prescribed in this ordinance are insufficient to prevent materials, in quantities that harm beneficial uses and violate State Water Quality Standards, from entering the county's water resources or adjacent properties, the county may require additional measures from the Erosion Control Manual to be implemented.

### **B. Drainage leaving a site**

1. Runoff discharges from a site shall occur at their natural location and elevation, unless runoff is conveyed in a constructed system, approved by the county.
2. Surface runoff exiting a parcel shall be discharged with adequate energy dissipators within the development site to prevent downstream damage.

### **C. Stormwater and sanitary sewers**

Connecting storm sewers, roof drains, or other stormwater or groundwater carrying pipes and culverts to sanitary sewers or septic systems is prohibited. Allowing surface storm drainage from ditches, overland flow, or through other means to drain into sanitary sewers or septic systems is also prohibited.

### **D. Fills in flood storage areas**

In order to control flooding of downstream properties, all wetland fills and fills of low areas where runoff is naturally stored during 100-year storms, must be mitigated by creation of an equivalent amount of runoff storage within 1000 feet of the filled site.

### **E. Conveyance**

1. Conveyance systems shall be designed to carry runoff from the 25-year storm where the contributing drainage area is less than 40 acres and the 100-year storm where the contributing drainage area exceeds 40 acres.
2. Runoff from the 100-year storm may leave pipes and channels, but shall not rise to elevations more than one (1) foot below that of the lowest finished floor of buildings.

### **F. Stormwater Easements**

1. Stormwater easements shall be provided to the county or state for emergency maintenance of all stormwater facilities created within new subdivisions.
2. The parties responsible maintenance of these stormwater facilities shall be identified and approved by the county during the subdivision review process.
3. Responsibility for maintenance of these stormwater facilities shall be enforced by maintenance agreements running with the land.
4. If the county needs to maintain a stormwater facility, the property owner shall be liable for reimbursement to the county for the cost of this maintenance.
5. The requirements for stormwater easements include:
  - a. For pipes, culverts, and storm sewers, easements shall be 20 feet wide and centered on the pipe.
  - b. For stormwater facilities that are not enclosed, the easements shall include the open water plus 10 feet horizontally from the ordinary high water mark.
  - c. Excluded from easements shall be any existing private buildings.
  - d. No new buildings or other structures, which prevent access, are permitted within easements. The zonal setbacks of no less than a 10 foot setback shall be maintained from the easement to the dwelling or accessory structure so as to provide unimpeded access to the stormwater easement by emergency maintenance vehicles. Fences crossing or bordering easements shall provide gates of sufficient width to allow access by maintenance vehicles to the easement.

**G. Design Parameters**

1. Analysis to determine the pre and post-development flows from a site shall be based on the Santa Barbara Urban Hydrograph (SBUH) method as described in Appendix C.
2. Runoff curve numbers used in analysis of runoff shall be based on those contained in Appendix B.
3. Design of biofiltration swales shall be in accordance with Appendix D.

**H. Sites with Septic Systems**

On sites with septic systems where construction of stormwater facilities may disrupt the biotic action of the septic system, approval of the stormwater facility by the County Sanitarian is required.

**I. Other Permits**

Meeting the requirements of this ordinance does not eliminate the need to secure other required approvals and permits from other jurisdictions for activities covered under this ordinance. Other permits include, but are not limited to, NPDES Stormwater Permits, wetland permits, flood plain permits, Department of Geology and Mineral Industries (DOGAMI) permits, and water rights permits.

### **III. STANDARDS SPECIFIC TO ACTIVITIES**

The following requirements apply, in addition to the General Requirements above, to activities meeting the Applicability portion of this ordinance. Requirements citing a section number refer to the portion of the Erosion Control Manual (ECM) where a complete description of the practice can be found. Erosion control practices shall be installed and maintained as prescribed in the manual.

#### **A. Building Permits for Single Family, Duplex, and Associated Accessory Uses**

1. *Erosion Control*
  - a. Required Measures
    - i. A Gravel Construction Entrance (ECM-Section 3.3.1) shall be installed prior to the beginning of grading.
    - ii. Where slopes exceed 5%, a Sediment Fence (ECM-Section 3.3.2) shall be installed at the base of the disturbed area or dirt stockpiles.
    - iii. As an alternative to a sediment fence, vegetated and undisturbed buffers at the base of the slope on the subject property can be utilized. Slopes above the buffer cannot exceed 10% and the buffer width must be at least equal to the uphill disturbed area draining to it.
    - iv. During wet weather, October 1-April 30, a 6-mil plastic sheet cover (ECM-Section 3.3.9) or a minimum 2" of straw mulch cover shall be required on stockpiles where sediment is eroding and leaving the subject property or entering a water resource.
    - v. Ground cover shall be reestablished prior to removing the erosion control measures described above (ECM-Section 3.3.6).
  - b. Erosion Control Plan
    - i. A Final Erosion Control Plan may be required by the county on sites with known and apparent erosion problems.
    - ii. If required, the plan shall be prepared by an Engineer.
2. *Long Term Water Quality Protection*
  - a. Required Measures
    - i. Outside soil hazard areas, roof runoff shall not be piped or channeled directly to a ditch, stream, or other water resource. Instead, roof runoff shall be infiltrated into the ground from downspouts or allowed to disperse naturally on the ground. In all cases, however, runoff shall be directed away from septic systems.
    - ii. Where driveway runoff is channeled to a stream, roadside ditch, or other water resource, the driveway runoff shall flow through a vegetation-lined channel or swale running adjacent to the driveway prior to reaching the water resource. Where possible, the vegetation-lined channel shall be at least 100 feet long.
  - b. Stormwater Plan  
A stormwater plan is not required.

#### **B. Building Permits for Commercial, Industrial, Multi-Family, and Associated Accessory Uses**

1. *Erosion Control*
  - a. Required Measures
    - i. A Gravel Construction Entrance (ECM-Section 3.3.1) shall be installed prior to the beginning of grading.
    - ii. Where slopes exceed 5%, a Sediment Fence (ECM-Section 3.3.2) shall be installed at the base of the disturbed area or dirt stockpiles.
    - iii. On slopes exceeding 10%, sediment fences are required at intervals specified in Table 3-2 of the Erosion Control Manual.
    - iv. As an alternative to a sediment fence, vegetated and undisturbed buffers at the base of the slope on the subject property can be utilized. Slopes above the buffer cannot exceed 10% and the buffer width must be at least equal to the uphill-disturbed area

- v. During wet weather, October 1-April 30, a 6-mil plastic sheet cover (ECM-Section 3.3.9) or a minimum 2" of straw mulch cover shall be required on stockpiles where sediment is eroding and leaving the subject property or entering a water resource.
    - vi. Ground cover shall be reestablished prior to removing the erosion control measures described above (ECM-Section 3.3.6).
  - b. Erosion Control Plan
    - i. A Final Erosion Control Plan is required.
    - ii. The plan shall be prepared by an Engineer.
    - iii. The plan shall specify use of the erosion control measures outlined above, plus additional measures as may be necessary to prevent sediment from leaving the subject property or entering a water resource.
    - iv. The plan shall be completed in the format specified in Section IV.
    - v. The plan shall be submitted to the county with the building permit application.
    - vi. A building permit will not be issued until the plan is approved by the county.
- 2. *Long Term Water Quality Protection*
  - a. Required Treatment Measures
    - i. Runoff from parking lots, driveways, and other exposed traffic areas shall be treated using one of the following treatment methods: biofiltration swales, vegetative filter strips, or *alternative treatment methods*
    - ii. Treatment methods shall be sized to treat the water quality storm.
    - iii. Biofiltration swales and vegetative filter strips shall be sized for a 9-minute hydraulic residence time.
    - iv. Oil/water separators shall be required for activities exhibiting a significant risk of high oil loading in runoff, oil spills, or illegal dumping of oil or grease.
  - b. Required Runoff Control Measures
    - i. Runoff from the development site shall be controlled such that the following criteria are met:
      - A) The peak flows for the 10 and 100-year design storms after development does not exceed the respective pre-development peak flows.
      - B) The peak flow for the 2-year design storm after development does not exceed one-half the pre-development peak flow for the 2-year storm.
    - ii. Discharges directly into tidal waterbodies are exempt from the above runoff control measures, but not treatment requirements.
  - c. Stormwater Plan
    - i. A Final Stormwater Plan is required.
    - ii. The plan shall be prepared by an Engineer.
    - iii. The plan shall specify use of the treatment and runoff control measures outlined above.
    - iv. The plan shall be completed in the format specified in Section IV.
    - v. The plan shall be submitted to the county with the building permit application.
    - vi. A building permit will not be issued until the plan is approved by the county.

## C. Grading Permits

- 1. *Erosion Control*
  - a. Required Measures
    - i. A Gravel Construction Entrance (ECM-Section 3.3.1) shall be installed prior to the beginning of grading.
    - ii. Where slopes exceed 5%, a Sediment Fence (ECM-Section 3.3.2) shall be installed at the base of the disturbed area or dirt stockpiles.
    - iii. As an alternative to a sediment fence, vegetated and undisturbed



- iv. During wet weather, October 1-April 30, a 6-mil plastic sheet cover (ECM-Section 3.3.9) or a minimum 2" of straw mulch cover shall be required on stockpiles where sediment is eroding and leaving the subject property or entering a water resource.
    - v. Ground cover shall be reestablished prior to removing the erosion control measures described above (ECM-Section 3.3.6).
  - b. Erosion Control Plan
    - An erosion control plan is not required.
- 2. *Long Term Water Quality Protection*
  - a. No long-term water quality treatment and runoff control measures are required for grading permits.
  - b. No stormwater plans are required for grading permits.

## D. Partitions

1. *Erosion Control*  
Erosion control measures and an erosion control plan are not required for partitions.
2. *Long Term Water Quality Protection*
  - a. A Conceptual Stormwater Plan is required for single family and duplex parcels. A Preliminary Stormwater Plan is required for partitions of multi-family, commercial, and industrial parcels.
  - b. The Preliminary Stormwater Plans shall be prepared by Engineer. The applicant may prepare Conceptual Stormwater Plans.
  - c. The plan shall describe how the treatment and runoff control measures required for future building permits on the parcels will be achieved.
  - d. The plan shall be completed in the format specified in Section IV.
  - e. The plan shall be submitted to the county with the partition application.
  - f. The partition will not be approved until the plan is approved by the county.

## E. Subdivisions

1. *Erosion Control*
  - a. Required Measures
    - i. A Gravel Construction Entrance (ECM-Section 3.3.1) shall be installed prior to the beginning of grading.
    - ii. Where slopes exceed 5%, a Sediment Fence (ECM-Section 3.3.2) shall be installed at the base of the disturbed area or dirt stockpiles.
    - iii. On slopes exceeding 10%, sediment fences are required at intervals specified in Table 3-2 of the Erosion Control Manual.
    - iv. As an alternative to a sediment fence, vegetated and undisturbed buffers at the base of the slope on the subject property can be utilized. Slopes above the buffer cannot exceed 10% and the buffer width must be at least equal to the uphill-disturbed area draining to it.
    - v. During wet weather, October 1-April 30, a 6-mil plastic sheet cover (ECM-Section 3.3.9) or a minimum 2" of straw mulch cover shall be required on stockpiles where sediment is eroding and leaving the subject property or entering a water resource.
    - vi. Ground cover shall be reestablished prior to removing the erosion control measures described above (ECM-Section 3.3.6).
  - b. Erosion Control Plans
    - i. Preliminary and Final Erosion Control Plans are required.
    - ii. The plans shall be prepared by an Engineer.
    - iii. The plans shall specify use of the erosion control measures outlined above, plus additional measures as may be necessary to prevent sediment from leaving the subject property or entering a

- iv. water resource.
  - v. The plans shall be completed in the format specified in Section IV.
  - vi. The preliminary plan shall be submitted to the county with the subdivision application. The final plan shall be submitted to the county with the final engineering plans.
  - vii. Subdivision approval will not occur until the preliminary plan is approved by the county.
  - viii. Construction and grading on the site shall not begin until the final plan is approved by the county and required erosion control measures are in place.
- 2. *Long Term Water Quality Protection*
  - a. Required Treatment Measures
    - i. Runoff from parking lots, driveways, and other exposed traffic areas shall be treated using one of the following treatment methods: biofiltration swales, vegetative filter strips, alternative treatment methods.
    - ii. Treatment methods shall be sized to treat the water quality storm.
    - iii. Biofiltration swales and vegetative filter strips shall be sized for a 9-minute hydraulic residence time.
    - iv. Oil/water separators shall be required on commercial and industrial sites for activities exhibiting a significant risk of high oil loading in runoff, oil spills, or illegal dumping of oil or grease.
  - b. Required Runoff Control Measures
    - i. Runoff from the development site shall be controlled such that the following criteria are met:
      - A) The peak flows for the 10 and 100-year design storms after development does not exceed the respective pre-development peak flows.
      - B) The peak flow for the 2-year design storm after development does not exceed one-half the pre-development peak flow for the 2-year storm.
    - ii. Discharges directly into tidal waterbodies are exempt from the above runoff control measures but not treatment requirements.
  - c. Stormwater Plans
    - i. Preliminary and Final Stormwater Plans are required.
    - ii. The plans shall be prepared by an Engineer.
    - iii. The plans shall specify use of the treatment and runoff control measures outlined above.
    - iv. The plans shall be completed in the format specified in Section IV.
    - v. The preliminary plan shall be submitted to the county with the subdivision application. The final plan shall be submitted to the county with the final engineering plans.
    - vi. Subdivision approval will not occur until the preliminary plan is approved by the county.
    - vii. Construction and grading on the site shall not begin until the final plan is approved by the county and required erosion control measures are in place.

## **F. Construction of New Public Roads**

- 1. *Erosion Control*
  - a. Required Measures
    - i. Ground cover shall be reestablished prior to removing temporary erosion control measures (ECM-Section 3.3.6).
  - b. Erosion Control Plan
    - i. A Final Erosion Control Plan is required.
    - ii. The plan shall be prepared by an Engineer.
    - iii. The plan shall specify use of the erosion control measures necessary to prevent sediment from leaving the subject property or right of way or entering a water resource.
    - iv. The plan shall be completed in the format specified in Section IV.
    - v. Construction and grading for the project shall not begin until the

- plan is approved by the county and required erosion control measures are in place.
2. *Long Term Water Quality Protection*
    - a. Required Treatment Measures
      - i. Runoff from new pavement areas exposed to traffic shall be treated using one of the following treatment methods: biofiltration swales, vegetative filter strips, or alternative treatment methods
      - ii. Treatment methods shall be sized to treat the water quality storm.
      - iii. Biofiltration swales and vegetative filter strips shall be sized for a 9-minute hydraulic residence time.
    - b. Required Runoff Control Measures
      - i. Runoff from new impervious surfaces shall be controlled such that the following criteria are met:
        - A) The peak flows for the 10 and 100-year design storms after development does not exceed the respective pre-development peak flows.
        - B) The peak flow for the 2-year design storm after development does not exceed one-half the pre-development peak flow for the 2-year storm.
      - ii. Discharges directly into tidal waterbodies are exempt from the above runoff control measures but not treatment requirements.
    - c. Stormwater Plan
      - i. A Final Stormwater Plan is required.
      - ii. The plan shall be prepared by an Engineer.
      - iii. The plan shall specify use of the treatment and runoff control measures outlined above.
      - iv. The plan shall be completed in the format specified in Section IV.
      - v. Construction and grading for the project shall not begin until the plan is approved by the county and required erosion control measures are in place.

## **G. Drainage Modifications**

1. *Erosion Control*
  - a. Required Measures
    - i. During wet weather, October 1-April 30, a 6-mil plastic sheet cover (ECM-Section 3.3.9) or a minimum 2" of straw mulch cover shall be required on areas of exposed earth where sediment is eroding and entering a water resource.
    - ii. Ground cover shall be reestablished prior to removing erosion control measures (ECM-Section 3.3.6).
  - b. Erosion Control Plan
    - i. A Final Erosion Control Plan is required if more than 2000 square feet, or 1000 square feet on sites with known and apparent erosion problems, will be disturbed by the drainage modification.
    - ii. The plan shall be prepared by an Engineer.
    - iii. The plan shall specify use of the erosion control measures outlined above, plus additional measures as may be necessary to prevent sediment from entering a water resource.
    - iv. The plan shall be completed in the format specified in Section IV.
    - v. Construction on the site shall not begin until the plan is approved by the county.
2. *Long Term Water Quality Protection*
  - a. No long-term water quality treatment and runoff control measures are required for drainage modifications.
  - b. No stormwater plans are required for drainage modifications.

## **IV. OTHER PROVISIONS**

### **A. Preliminary Erosion Control Plan**

A preliminary erosion control plan shall contain the information outlined below. The

information shall be shown on one or more plan sheets that are drawn to scale. Narrative information can be included as notes on the plans.

1. *Existing Conditions Plan* showing:
  - a. Existing topography and flow directions for site runoff, including slope percentages
  - b. Existing drainage features including streams, ditches, ponds, and wetlands, on or adjacent to the site
  - c. Existing structures on the site
  - d. Existing vegetation on the site
  - e. Soil types on the site and an indication of their erosion potential
2. *Site Plan* showing:
  - a. Property boundaries, both existing and proposed
  - b. Adjacent land uses
  - c. Conceptual erosion control plan discussing which erosion control measures will be utilized with an indication of their approximate location
  - d. For commercial, multi-family, and industrial subdivisions, approximate locations of proposed structures on the site

## **B. Final Erosion Control Plan**

A final erosion control plan shall contain the information outlined below. The information shall be shown on one or more plan sheets that are drawn to scale. Narrative information can be included as notes on the plans.

1. *Existing Conditions Plan*

The information provided for the preliminary erosion plan is sufficient, assuming that information accurately reflects the current state of the site. If significant changes have occurred to the site, a revised existing conditions plan is required.
2. *Site Plan* showing:
  - a. Property boundaries, both existing and proposed, with dimensions
  - b. For commercial, multi-family, and industrial subdivisions, approximate locations of proposed structures on the site
3. *Erosion Control Plan* showing:
  - a. Locations and sizes (areas or lengths) of erosion control measures proposed to be used on the site during construction and after construction is completed.
  - b. Maintenance schedule for insuring the erosion control measures continue to function as they are designed to function.
  - c. For those measures requiring sizing calculations, a summary of the design calculations. This summary can be submitted in report form rather than shown on the plans.
  - d. Contingency plan discussing additional erosion control measures to be applied if the proposed measures fail or are insufficient to control erosion.
  - e. Discussion of how the site will be secured to prevent stormwater and erosion measures from being vandalized. A security fence with a locked gate or an on-site security guard are examples of methods to secure a large site.

## **C. Conceptual Stormwater Plan**

1. *Purpose*

The purpose of the conceptual stormwater plan is to determine whether a proposal can meet the requirements set forth in this ordinance. In general, the conceptual stormwater plan identifies how runoff originating on the site or flowing through the site is presently controlled and how this will change due to the proposed development activity.
2. *Format*

The conceptual stormwater control plan shall include a narrative and plan sheets drawn to scale.
3. *Contents*
  - a. Conceptual Stormwater Narrative

The conceptual stormwater narrative shall contain the following information:

- i. Site Location Map  
At a minimum a USGS 7.5 minute topo series map shall be used showing the following information:
  - A) Site boundaries or site location for small sites
  - B) Contributing drainage areas
- ii. Soils map from the Columbia County Soil Survey with the site highlighted
- iii. Flood plain map with the site highlighted, if the site is in a flood plain
- iv. Discussion of the methods to be used to treat runoff from paved surfaces on the site
- v. Discussion of the methods to be used to control the flow of stormwater runoff from the developed site. If infiltration is proposed, the discussion should include an analysis of the capability of on-site soils for infiltration of runoff, including the potential impacts on slope stability.
- vi. Discussion of who will maintain the stormwater facilities constructed in conjunction with the project
- vii. Listing of additional permits (e.g., wetland, flood plain, etc.) that may be required for the project
- b. Existing Conditions Plan  
This plan shall show the information outlined below.
  - i. Arrows showing the direction of drainage on the site
  - ii. Existing drainage features including streams, ditches, ponds, and wetlands, on or adjacent to the site
  - iii. Existing structures on the site
  - iv. Existing septic systems on the site
  - v. Existing vegetation on the site
  - vi. Soil types on the site
- c. Preliminary Development Plan  
This plan shall include the following information:
  - i. Existing and proposed property boundaries, easements, and right-of-ways
  - ii. Proposed building and road locations, if known

#### **D. Preliminary Stormwater Plan**

- 1. *Purpose*  
The purpose of the preliminary stormwater plan is to determine whether a proposal can meet the requirements set forth in this ordinance. In general, the preliminary stormwater plan identifies how runoff originating on the site or flowing through the site is presently controlled and how this will change due to the proposed development activity.
- 2. *Format*  
The preliminary stormwater control plan shall include a report and plan sheets drawn to scale. The report and plans shall be stamped, signed, and dated by an engineer.
- 3. *Contents*
  - a. Preliminary Stormwater Report  
The preliminary stormwater report shall contain the following information:
    - i. Site Location Map  
At a minimum a USGS 7.5 minute topo series map shall be used showing the following information:
      - A) Site boundaries or site location for small sites
      - B) Contributing drainage areas and their acreage
    - ii. Soils map from the Columbia County Soil Survey with the site highlighted
    - iii. Flood plain map with the site highlighted, if the site is in a flood plain
    - iv. Discussion of the methods to be used to treat runoff from paved surfaces on the site
    - v. Discussion of the methods to be used to control the flow of

- stormwater runoff from the developed site. If infiltration is proposed, the discussion should include an analysis of the capability of on-site soils for infiltration of runoff, including the potential impacts on slope stability and on-site sewage systems.
- vi. Calculations of the pre-development and post-development runoff from the site
- vii. Preliminary sizing calculations for the proposed stormwater facilities
- viii. Discussion of who will maintain the stormwater facilities constructed in conjunction with the project
- ix. Listing of additional permits (e.g., wetland, flood plain, etc.) that may be required for the project
- b. Existing Conditions Plan  
This plan shall show the information outlined below. If a preliminary erosion control plan is completed for the project, the same Existing Conditions Plan can be utilized.
  - i. Existing topography in 2-foot contours
  - ii. Existing drainage features including streams, ditches, ponds, and wetlands, on or adjacent to the site
  - iii. Existing structures on the site
  - iv. Existing septic systems on the site
  - v. Existing vegetation on the site
  - vi. Soil types on the site
- c. Preliminary Development Plan  
This plan shall include the following information:
  - i. Existing and proposed property boundaries, easements, and right-of-ways
  - ii. Proposed building, septic systems, and road locations, if known
  - iii. Approximate location and size of proposed stormwater facilities, including typical cross-sections of the proposed facilities

## **E. Final Stormwater Plan**

### *1. Purpose*

The final stormwater plan provides the final design and analysis of stormwater facilities on the site. The final stormwater plan consists of engineering construction plans and a detailed discussion, in report form, of the various aspects of stormwater design on the project.

### *2. Format*

- a. Engineering Plans
  - i. Plans shall be stamped, signed, and dated by an engineer.
  - ii. Typically engineering plans for a project shall contain, at a minimum, the sheets listed below. However, the engineer has the discretion to organize the plans differently, as long as the content requirements are met.
    - A) Site Plan
    - B) Grading and Erosion Control Plan
    - C) Stormwater Plan
    - D) Stormwater and Erosion Control Details
- b. Stormwater Report
  - i. The stormwater report shall be stamped, signed, and dated by an engineer
  - ii. The report shall be bound in a notebook or other type of binder. Drawings larger than 8-1/2 x 11 can be attached to the report
  - iii. A table of contents shall be included at the beginning of the report
  - iv. Detailed computations and software printouts utilized in the runoff analysis shall be included in the report appendix
  - v. Portions of the contents may be excluded, with county approval, if not applicable to the project

### *3. Contents*

- a. Engineering Plans  
The engineering plan set shall contain the following information:
  - i. Existing and proposed property boundaries, easements, and right-

- of-ways, including stormwater easements
  - ii. Existing and proposed topography in 2-foot contours, unless site topography makes a different contour interval more appropriate
  - iii. Existing drainage features including streams, ditches, ponds, flood plains, and wetlands, on or adjacent to the site
  - iv. Drainage flow routes through and on the site, including existing discharge points to and from the site
  - v. Proposed buildings, pavement areas, and other impervious surfaces
  - vi. Proposed stormwater treatment and runoff control facilities, in plan and cross-section
  - vii. Lengths, sizes, slopes, and materials of proposed storm sewers
  - viii. Inverts and rim elevations of storm manholes
  - ix. Cross sections and lengths of proposed open channel conveyance systems
  - x. Existing and proposed utilities
  - xi. Existing and proposed on-site sewage disposal systems;
  - xii. Details of erosion control measures proposed
  - xiii. Details with sizes, lengths, and inverts for any orifices or weirs used for flow control
- b. Stormwater Report
 

The stormwater report set shall contain the following information:

  - i. Maps:
    - A) Site location map  
At a minimum a USGS 7.5 minute topo series map shall be used showing site boundaries or site location for small sites and contributing drainage areas to the site
    - B) Soils map with site identified
    - C) Flood plain map with the site highlighted, if the site is in a flood plain
  - ii. Project Overview
    - A) Discussion of project scope and timing
    - B) Description of drainage to and from adjacent properties
    - C) Overview of methods used to mitigate stormwater impacts
    - D) Discussion of software and models used for computing runoff
    - E) If project went through an earlier review by the county, list approval conditions related to stormwater and describe how final plan meets the conditions
    - F) List additional permits (e.g., wetland, flood plain, etc.) that may be required for the project and discuss any impacts these permits have on the proposed stormwater facilities
  - iii. Pre-Development Analysis
    - A) Tabulate and discuss parameters impacting pre-development runoff calculations including curve numbers, impervious surface areas, slopes, and soil types and groups.
    - B) Compute and tabulate pre-development flows for the 2, 10, and 100-year storms for the various discharge points from the site
    - C) Compute and tabulate existing off-site flows entering the site for the 2, 10, and 100-year storms
    - D) Compute and tabulate off-site flows for the 2, 10, and 100-year storms at build out, if these flows will be different than the existing flows
    - E) Show on a map the point and basins included in the calculations
  - iv. Post Development Analysis
    - A) Tabulate and discuss parameters impacting post-development runoff calculations including curve numbers, impervious surface areas, slopes, and soil types and groups
    - B) Compute and tabulate post-development flows for the 2,

- 10, and 100-year storms for the various discharge points from the site
  - C) Compute the water quality storm flows that are required to be treated
  - D) Compute and tabulate runoff flows that are required to be detained for the 2, 10, and 100-year storms at the various discharge points from the site
- v. Runoff Treatment
  - A) Identify water quality storm runoff that will be treated
  - B) Describe runoff treatment method to be utilized
  - C) List design parameters utilized to size runoff treatment facilities
- vi. Runoff Quantity Control
  - A) Tabulate flow rates that are allowed to leave the site based on pre and post-development runoff analysis and the requirements in this ordinance
  - B) Describe runoff quantity control methods to be utilized
  - C) List design parameters utilized to size runoff treatment facilities
  - D) Compute and tabulate peak flow rates, storage volumes, and ponding elevations for all design storms
  - E) If infiltration of runoff is proposed: identify on-site soil types and discuss their suitability for the project; identify seasonal high water table elevations in relevant areas; identify on-site septic systems and discuss the impact of proposed infiltration facilities on these sewage systems; and discuss infiltration rates based on soil tests conducted by a geotechnical engineer.
- vii. Conveyance System
  - A) Identify criteria used in sizing conveyance system
  - B) Compute and tabulate design flows, velocities, and conveyance capacities for all parts of the proposed conveyance system
- viii. Maintenance
  - A) Identify who will maintain all parts of the stormwater system after completion
  - B) Describe operation and maintenance procedures for runoff treatment and quantity control facilities
- ix. Appendix
 

Include any reports and permits associated with the site that impact stormwater runoff analysis. Examples of these types of reports include: geotechnical and soil reports, wetland delineations, flood plain analysis, groundwater studies, wetland fill permits, and other applicable permits.



**APPENDIX A**  
**Summary Of Requirements For Erosion Control And Stormwater Plans**

	<b>Prel. Erosion Control</b>	<b>Final Erosion Control</b>	<b>Conceptual Stormwater Plan</b>	<b>Prel. Stormwater Plan</b>	<b>Final Stormwtr Plan</b>
Single Family & Duplex Bldg. Permits		Plan by an Engineer for sites with known and apparent erosion problems			
Comm, Ind., and MF Bldg. Permits		Plan by Engineer			Plan by Engineer
Grading Permits					
Partitions – Single Family & Duplex			Plan by applicant		
Partitions – Multi-family, Commercial, & Industrial				Plan by Engineer	
Subdivisions	Plan by an Engineer	Plan by an Engineer		Plan by an Engineer	Plan by an Engineer
Construction of new public roads		Plan by an Engineer			Plan by an Engineer
Drainage modifications		Plan by an Engineer if area disturbed exceeds 2000 sq.ft. or 1000 sq.ft. on sites with known erosion problems			

Shaded areas indicate when various types of plans are not required.

## APPENDIX B Runoff Curve Numbers

The runoff curve numbers shown below are for selected agricultural, suburban and urban land use for a Type 1A rainfall distribution, 24-hour storm duration. The curve numbers are for *wet* antecedent conditions.

The curve numbers originate from SCS Publications, TR55, "Urban Hydrology for Small Watersheds," June 1986.

		Curve Numbers by Hydrologic Group			
Land Use Description		A	B	C	D
Cultivated land:	Winter condition	89	94	97	98
Mountain open areas:	Low-growing brush and grasslands	68	83	89	93
Meadow or pasture:	Continuous forage for grazing <50% groundcover or heavily grazed with no mulch	68	79	86	89
Wood or forest land:	Undisturbed or older second growth	45	66	76	83
Orchard:	With crop cover	75	87	92	94
Open spaces, lawns, parks, golf courses, cemeteries, and landscaping					
Good condition:	Grass cover on 75% or more of area	59	78	88	91
Fair condition:	Grass cover on 50% to 75% of area	69	84	91	93
Poor condition:	Grass cover <50%	84	91	94	96
Gravel roads and parking lots		89	94	96	97
Dirt roads and parking lots		86	92	95	96
Impervious surfaces, pavement, roofs, etc.		99	99	99	99
Open water bodies:	Lakes, wetlands, ponds, etc.	100	100	100	100
Single Family Residential (See note 1)					
Dwelling Unit/Gross Acre	% Impervious (See note 2)	Separate curve number shall be selected for pervious and impervious portion of the site or basin.			
1.0 DU/GA	15				
1.5 DU/GA	20				
2.0 DU/GA	25				
2.5 DU/GA	30				
3.0 DU/GA	34				
3.5 DU/GA	38				
4.0 DU/GA	42				
4.5 DU/GA	46				
5.0 DU/GA	48				
5.5 DU/GA	50				
6.0 DU/GA	52				
6.5 DU/GA	54				
7.0 DU/GA	56				
Planned unit developments, condominiums, apartments, commercial business, and industrial areas.	% of impervious must be computed.	Separate curve number shall be selected for pervious and impervious portion of the site or basin.			

### Notes:

Assumes roof and driveway runoff is directed into street/storm system.

The remaining pervious areas (lawn) are considered to be in good condition for these curve numbers.

## APPENDIX C

### Santa Barbara Unit Hydrograph Method

#### **INTRODUCTION**

The Santa Barbara Urban Hydrograph (SBUH) method was developed by the Santa Barbara County Flood Control and Water Conservation District to determine a runoff hydrograph for an urbanized area. It is a simpler method than some other approaches, as it computes a hydrograph directly without going through intermediate steps (i.e., a unit hydrograph) to determine the runoff hydrograph.

The SBUH method is a popular method for calculating runoff, since it can be done with a spreadsheet or by hand relatively easily. The SBUH method is the method approved by Columbia County for determining runoff when doing runoff calculations under this ordinance.

A variety of computer software packages are available to do SBUH calculations. In addition, a DOS-based computer program, HYD, was developed by the King County, Washington, Department of Public Works to do Santa Barbara hydrograph calculations. Copies of HYD are available from Columbia County at no cost.

#### **ELEMENTS OF THE SBUH METHOD**

The SBUH method depends on several variables:

- Pervious ( $A_p$ ) and impervious ( $A_{imp}$ ) land areas
- Time of concentration ( $T_c$ ) calculations
- Runoff curve numbers (CN) applicable to the site
- Design storm

When stormwater plans developed by an Engineer are required, these elements shall all be presented as part of the submittal process for review by county staff. In addition, maps showing the pre-development and post-development conditions shall be presented to help in the review.

A discussion of the key variables used in the SBUH method is presented below.

##### *Land Area*

The total area, including the pervious and impervious areas within a drainage basin, must be quantified in order to evaluate critical contributing areas and the resulting site runoff. Each area within a basin shall be analyzed separately and their hydrographs combined to determine the total basin hydrograph. Areas shall be selected to represent homogenous land use/development units.

##### *Time of Concentration*

Time of concentration,  $T_c$ , is the time for a theoretical drop of water to travel from the furthest point in the drainage basin to the facility being designed. (In this case,  $T_c$  is derived by calculating the overland flow time of concentration and the channelized flow time of concentration.)  $T_c$  depends on several factors, including ground slope, ground roughness, and distance of flow.

When calculating  $T_c$ , the following limitations generally apply:

- Overland sheet flow (flow across flat areas that does not form into channels or rivulets) shall not extend for more than 300 feet, and travel time shall not exceed 25 minutes.
- For flow paths through closed conveyance facilities such as pipes and culverts, standard hydraulic formulas shall be used for establishing velocity and travel time.
- Flow paths through lakes or wetlands may be assumed to be zero (i.e.  $T_c = 0$ ).

##### *Runoff Curve Numbers*

Runoff curve numbers were developed by the Natural Resources Conservation Service (NRCS) after studying the runoff characteristics of various types of land. Curve numbers

(CN) were developed to reduce diverse characteristics such as soil type, land usage, and vegetation into a single variable for doing runoff calculations. The runoff curve numbers approved by Columbia County for runoff calculations are included in Appendix B.

The curve numbers presented in Appendix B are for wet antecedent moisture conditions. Wet conditions assume previous rainstorms have reduced the capacity of soil to absorb water. Given the frequency of rainstorms in the northwest Oregon, wet conditions are most likely, and give conservative hydrographic values.

#### *Design Storm*

The SBUH method also requires a design storm to perform the runoff calculations. For runoff calculations, Columbia County uses a NRCS Type 1A 24-hour storm. The depth of rainfall for the water quality storm is 0.83 inches of water. The rainfall totals for various design storms are provided in the Definitions section of the ordinance. The table below shows the rainfall distribution for a Type 1A storm.

# **NRCS Type 1A Hyetographic Distribution For Use In Water Quality/Quantity Design**

Time from Start of Storm (minutes)	Perce nt Rainfa ll	Cumu- lative Percent Rainfall
0 - 10	0.40	0.40
10 - 20	0.40	0.80
20 - 30	0.40	1.20
30 - 40	0.40	1.60
40 - 50	0.40	2.00
50 - 60	0.40	2.40
60 - 70	0.40	2.80
70 - 80	0.40	3.20
80 - 90	0.40	3.60
90 - 100	0.40	4.00
100 - 110	0.50	4.50
110 - 120	0.50	5.00
120 - 130	0.50	5.50
130 - 140	0.50	6.00
140 - 150	0.50	6.50
150 - 160	0.50	7.00
160 - 170	0.60	7.60
170 - 180	0.60	8.20
180 - 190	0.60	8.80
190 - 200	0.60	9.40
200 - 210	0.60	10.00
210 - 220	0.60	10.60
220 - 230	0.70	11.30
230 - 240	0.70	12.00
240 - 250	0.70	12.70
250 - 260	0.70	13.40
260 - 270	0.70	14.10
270 - 280	0.70	14.80
280 - 290	0.82	15.62
290 - 300	0.82	16.44
300 - 310	0.82	17.26
310 - 320	0.82	18.08
320 - 330	0.82	18.90
330 - 340	0.82	19.72
340 - 350	0.95	20.67
350 - 360	0.95	21.62
360 - 370	0.95	22.57
370 - 380	0.95	23.52
380 - 390	0.95	24.47
390 - 400	0.95	25.42
400 - 410	1.34	26.76
410 - 420	1.34	28.10
420 - 430	1.34	29.44
430 - 440	1.80	31.24
440 - 450	1.80	33.04
450 - 460	3.40	36.44
460 - 470	5.40	41.84
470 - 480	2.70	44.54

Time from Start of Storm (minutes)	Perce nt Rainfal l	Cumu- lative Percent Rainfall
480 - 490	1.80	46.34
490 - 500	1.34	47.68
500 - 510	1.34	49.02
510 - 520	1.34	50.36
520 - 530	0.88	51.24
530 - 540	0.88	52.12
540 - 550	0.88	53.00
550 - 560	0.88	53.88
560 - 570	0.88	54.76
570 - 580	0.88	55.64
580 - 590	0.88	56.52
590 - 600	0.88	57.40
600 - 610	0.88	58.28
610 - 620	0.88	59.16
620 - 630	0.88	60.04
630 - 640	0.88	60.92
640 - 650	0.72	61.64
650 - 660	0.72	62.36
660 - 670	0.72	63.08
670 - 680	0.72	63.80
680 - 690	0.72	64.52
690 - 700	0.72	65.24
700 - 710	0.72	65.96
710 - 720	0.72	66.68
720 - 730	0.72	67.40
730 - 740	0.72	68.12
740 - 750	0.72	68.84
750 - 760	0.72	69.56
760 - 770	0.57	70.13
770 - 780	0.57	70.70
780 - 790	0.57	71.27
790 - 800	0.57	71.84
800 - 810	0.57	72.41
810 - 820	0.57	72.98
820 - 830	0.57	73.55
830 - 840	0.57	74.12
840 - 850	0.57	74.69
850 - 860	0.57	75.26
860 - 870	0.57	75.83
870 - 880	0.57	76.40
880 - 890	0.50	76.90
890 - 900	0.50	77.40
900 - 910	0.50	77.90
910 - 920	0.50	78.40
920 - 930	0.50	78.90
930 - 940	0.50	79.40
940 - 950	0.50	79.90
950 - 960	0.50	80.40

Time from Start of Storm (minutes)	Perce nt Rainfal l	Cumu- lative Percent Rainfall
960 - 970	0.50	80.90
970 - 980	0.50	81.40
980 - 990	0.50	81.90
990 - 1000	0.50	82.40
1000 - 1010	0.40	82.80
1010 - 1020	0.40	83.20
1020 - 1030	0.40	83.60
1030 - 1040	0.40	84.00
1040 - 1050	0.40	84.40
1050 - 1060	0.40	84.80
1060 - 1070	0.40	85.20
1070 - 1080	0.40	85.60
1080 - 1090	0.40	86.00
1090 - 1100	0.40	86.40
1100 - 1110	0.40	86.80
1110 - 1120	0.40	87.20
1120 - 1130	0.40	87.60
1130 - 1140	0.40	88.00
1140 - 1150	0.40	88.40
1150 - 1160	0.40	88.80
1160 - 1170	0.40	89.20
1170 - 1180	0.40	89.60
1180 - 1190	0.40	90.00
1190 - 1200	0.40	90.40
1200 - 1210	0.40	90.80
1210 - 1220	0.40	91.20
1220 - 1230	0.40	91.60
1230 - 1240	0.40	92.00
1240 - 1250	0.40	92.40
1250 - 1260	0.40	92.80
1260 - 1270	0.40	93.20
1270 - 1280	0.40	93.60
1280 - 1290	0.40	94.00
1290 - 1300	0.40	94.40
1300 - 1310	0.40	94.80
1310 - 1320	0.40	95.20
1320 - 1330	0.40	95.60
1330 - 1340	0.40	96.00
1340 - 1350	0.40	96.40
1350 - 1360	0.40	96.80
1360 - 1370	0.40	97.20
1370 - 1380	0.40	97.60
1380 - 1390	0.40	98.00
1390 - 1400	0.40	98.40
1400 - 1410	0.40	98.80
1410 - 1420	0.40	99.20
1420 - 1430	0.40	99.60
1430 - 1440	0.40	100.00

## **APPENDIX D**

### **Design of Biofiltration Swales**

#### **INTRODUCTION**

Biofiltration swales or grassy swales are vegetated open channels that trap pollutants through filtration. Swales are intended to serve areas of less than 10 acres. They can be used in all types of soils. However, when used in type A and B soils (NRCS classification) liners are required due to the permeability of these soils.

The maximum side slopes in the bottom 6 inches of swales should be not steeper than 4(horizontal) to 1(vertical).

#### **DESIGN CRITERIA**

Swales shall be designed in accordance with the following criteria:

- 1) The swale width and profile shall be designed to convey the water quality design storm event at:
  - Maximum design depth of 0.33 foot
  - Maximum design velocity of 0.9 foot per second
  - Hydraulic residence time (time for  $Q_{max}$  to pass through the swale) of 9 minutes
  - Minimum longitudinal slope of 1.5% and maximum slope of 5%. (On steep sides, check dams may be used to achieve a maximum longitudinal slopes in the swale of 5%).
  - Manning "n" value of 0.25
  - 4:1 (or flatter) side slopes in the treatment area
  - Minimum length of 100 feet
  - A minimum of 1 foot of freeboard above the standard storm design water surface shall be provided for facilities not protected by high-flow storm diversion devices.
  - Velocity through the facility shall not exceed 3 feet per second (fps) during the high-flow events (i.e., flows greater than those resulting from the water quality design storm).
- 2) Woody or shrubby vegetation shall not be planted in the active treatment area of the swale.
- 3) The swale shall incorporate a flow-spreading device at the inlet. The flow spreader shall provide a uniform flow distribution across the swale bottom. In swales with a bottom width greater than 8 feet, a flow spreader shall be installed at least every 50 feet.
- 4) To minimize flow channelization, the swale bottom shall be smooth, with uniform longitudinal slope, and with a minimum bottom width of 6 inches. Check dams may need to be installed to reduce flow channelization.
- 5) Grasses shall be established as soon as possible after the swale is completed. Grasses shall be seeded within 2 days. The initial rate of application shall be 5 pounds of seed mix per 1,000 square feet.
- 6) Swales shall be designed for flow resulting from the water quality design storm (0.83 inches in 24 hours). Storm events exceeding the water quality design storm shall be directed around the swale.
- 7) If needed, biodegradable erosion control matting appropriate for low-velocity flows (approximately 1 fps) shall be installed in the flow area of the swale prior to allowing water to flow through the swale.

## GRASS CHARACTERISTICS FOR SWALES

The characteristics listed below are desirable for a grass seed mix used in a vegetated swale. This list is not all-inclusive, but gives the primary characteristics that should be considered when formulating a grass seed mix. Vegetation for a swale should also be based on soil type and swale slope. A designer interested in seed should use the following grass characteristics as a basis for design.

- The grass shall have the ability to form densities of between 600 and 1,600 blades per square foot.
- The seed mix shall form a uniform distribution of grass. For example, the grass shall not grow in clumps where there will be patches of exposed soil between clumps.
- The grass shall provide erosion resistance given the peak design velocities.
- The grass shall have the ability to grow up through thin deposits of sediment.
- The grass shall have the ability to survive in periods of temporary inundation by water. The period of inundation will depend on the swale slope and the outlet structure. If a swale is located in an area of groundwater interception, a wetland-type grass is recommended.
- The grass shall have the ability to survive through this region's typical seasonal drought.
- The grass mix shall reach a minimum of 6 inches in height. The design flow depth recommended for swales is 3 inches, and the grass shall be at least twice this depth. If a swale is designed for a flow depth greater than 3 inches, it is recommended that grass height three times the design flow depth be maintained. In general, no swale shall have a design flow depth of greater than 6 inches.

## APPENDIX E

### Design Storms for Columbia County

The design storms for Columbia County are based on Isopluvial maps in the NOAA (National Oceanic and Atmospheric Administration) Atlas 2, Volume X, Figure 30. These maps are also available on the Internet at <http://www.wrcc.dri.edu>.

The design storms for various parts of Columbia County, that are to be used in conjunction with this ordinance, are shown in the table below.

	<i>Inches of Rainfall Resulting from Various 24-Hour Storms</i>						
	Water Quality	2-year	5-year	10-	25-	50-	100-
St. Helens	0.67	2.0	2.5	3.0	3.4	3.6	4.0
Vernonia	0.67	2.0	2.5	3.0	3.5	4.0	4.5
Mist	0.67	2.0	2.5	3.0	3.7	4.2	4.6
Scappoose	0.80	2.4	2.8	3.3	3.8	4.1	4.7
Rainier	0.80	2.4	2.9	3.4	3.9	4.4	4.8
Clatskanie	0.93	2.8	3.4	3.9	4.5	5.0	5.4
US 30 & Clatsop Co. Line	1.17	3.5	4.2	5.0	5.7	6.2	7.0
Above 1000 feet	1.0	3.0	3.5	4.0	4.5	5.0	5.5

Notes:

The Water Quality Storm equals one-third the 2-year storm.

For sites below 1000 feet, the rainfall corresponding to the nearest point in the above chart shall be used for the design storm.